WATER SUPPLY OUTLOOK
and
FEDERAL - STATE - PRIVATE COOPERATIVE SNOW SURVEYS
for
WESTERN UNITED STATES
Including Columbia River Drainage in Canada

UNITED STATES DEPARTMENT of AGRICULTURE—SOIL CONSERVATION SERVICE
Collaborating with
CALIFORNIA DEPARTMENT of WATER RESOURCES
and
BRITISH COLUMBIA DEPARTMENT of
LANDS, FORESTS and WATER RESOURCES

AS OF
MAY 1, 1963

UNITED STATES DEPARTMENT OF AGRICULTURE - SOIL CONSERVATION SERVICE

To Recipients of Water Supply Outlook Reports:

The climate of the cultivated and populated areas of the West is characterized by relatively dry summer months. Such precipitation as occurs falls mostly in the winter and early spring months when it is of little immediate benefit to growing crops. Most of this precipitation falls as mountain snow which stays on the ground for months, melting later to sustain streamflow during the period of greatest demand during late spring and summer. Thus, nature provides in mountain snow an imposing water storage facility.

The amount of water stored in mountain snow varies from place to place as well as from year to year and accordingly, so does the runoff of the streams. The best seasonal management of variable western water supplies results from advance estimates of the streamflow.

A snow survey consists of a series of about ten samples taken with specially designed snow sampling equipment along a permanently marked line, up to 1000 feet in length, called a snow course. The use of snow sampling equipment provides snow depth and water equivalent values for each sampling point. The average of these values is reported as the snow survey measurement for a snow course.

Snow surveys are made monthly or semi-monthly beginning in January or February and continue through the snow season until April, May or June. Currently more than 1400 western snow courses are measured each year. These measurements furnish the key data for water supply forecasts.

Streamflow forecasts are obtained by a comparison of total or maximum snow accumulation, as measured by snow water equivalent, to the subsequent spring and summer or snowmelt season runoff over a period of years. The snow water equivalent measured in selected snow courses provides most of the index to the streamflow forecast for the following season. More accurate forecasts are usually obtained when other factors such as soil moisture, base flow and spring precipitation are considered and included in the forecast procedure. Early season forecasts assume average climatic conditions through the snowmelt season.

Listed below are the Federal-State-Private Cooperative Snow Survey and Water Supply Forecast reports available for the West which contain detailed information on snow survey measurements, streamflow forecasts, reservoir storage, soil moisture and other guide data to water management and conservation decisions. Soil Conservation Service Reports may be secured from Water Supply Forecasting Unit, Soil Conservation Service, P.O. Box 4170, Portland 8, Oregon.

PUBLISHED BY SOIL CONSERVATION SERVICE

REPORTS	ISSUED	LOCATION	COOPERATING WITH
RIVER BASINS			
WESTERN UNITED STATES	MONTHLY (FEB.-MAY)	PORTLAND, OREGON	ALL COOPERATORS
STATES			
ALASKA	MONTHLY (MAR.-MAY)	PALMER, ALASKA	ALASKA S.C.D.
ARIZONA	SEMI-MONTHLY (JAN.15 - APR.1)	PHOENIX, ARIZONA	SALT R. VALLEY WATER USERS ASSOC. ARIZ. AGR. EXP. STATION
COLORADO AND NEW MEXICO	MONTHLY (FEB.-MAY)	FORT COLLINS, COLORADO	COLO. STATE UNIVERSITY COLO. STATE ENGINEER N. MEX. STATE ENGINEER
IDAHO	MONTHLY (JAN.-JUNE)	BOISE, IDAHO	IDAHO STATE RECLAMATION ENGINEER
MONTANA	MONTHLY (JAN.-JUNE)	BOZEMAN, MONTANA	MONT. AGR. EXP. STATION
NEVADA	MONTHLY (JAN.-MAY)	RENO, NEVADA	NEVADA DEPT. OF CONSERVATION AND NATURAL RESOURCES - DIVISION OF WATER RESOURCES
OREGON	MONTHLY (JAN.-JUNE)	PORTLAND, OREGON	OREG. STATE UNIVERSITY OREGON STATE ENGINEER
UTAH	MONTHLY (JAN.-JUNE)	SALT LAKE CITY, UTAH	UTAH STATE ENGINEER
WASHINGTON	MONTHLY (FEB.-JUNE)	SPOKANE, WASHINGTON	WN. STATE DEPT. OF CONSERVATION
WYOMING	MONTHLY (FEB.-JUNE)	CASPER, WYOMING	WYOMING STATE ENGINEER

PUBLISHED BY OTHER AGENCIES

REPORTS	ISSUED	AGENCY
BRITISH COLUMBIA	MONTHLY (FEB.-JUNE)	WATER RIGHTS BR., DEPT. OF LANDS, FORESTS AND NATURAL RESOURCES, PARLIAMENT BLDG., VICTORIA, B.C., CANADA
CALIFORNIA	MONTHLY (FEB.-MAY)	CALIF. DEPT. OF WATER RESOURCES, P.O. BOX 388, SACRAMENTO, CALIF.

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ISSUED

MAY 8, 1963

The Soil Conservation Service coordinates Snow Surveys conducted by its staff and many cooperators, including the Bureau of Reclamation, Corps of Engineers, Forest Service, National Park Service, Geological Surveys, and other Federal Agencies, Departments of State Government, Irrigation Districts, Power Companies, and others.

The Department of Water Resources coordinates snow surveys in California.

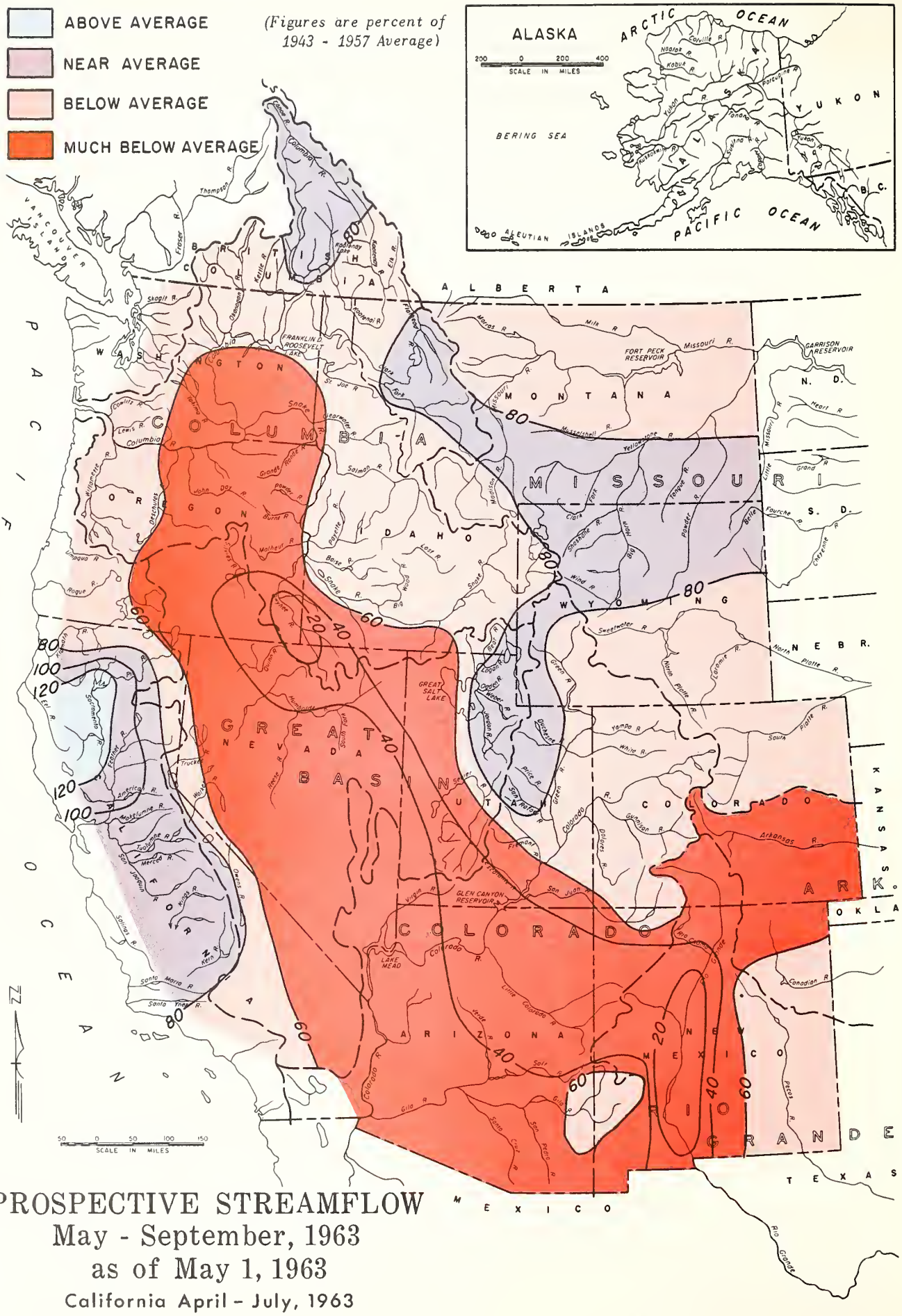
The Water Resources Service, Department of Lands, Forests, and Water Resources directs snow surveys in British Columbia.

This report is prepared under the direction of R. A. Work, Head, Water Supply Forecasting Unit, Soil Conservation Service, Portland, Oregon, from data and reports supplied by Snow Survey Supervisors of the Soil Conservation Service: Arizona, Richard W. Enz; Colorado and New Mexico, Jack N. Washichek; Idaho, M. W. Nelson; Montana, Phil E. Farnes; Nevada, Manes Barton; Oregon, W. T. Frost; Utah, Gregory L. Pearson; Washington, Robert T. Davis; Wyoming, George W. Peak.

California....Dept. of Water Resources, Robert W. Miller, Chief, Water Supply Forecast and Snow Surveys Unit.

British Columbia.....Dept. of Lands, Forests, and Water Resources, Harry I. Hunter, Meteorologist, Water Rights Branch.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
D. A. Williams, Administrator



PROSPECTIVE STREAMFLOW

May - September, 1963

as of May 1, 1963

California April - July, 1963

WATER SUPPLY OUTLOOK

As of May 1, 1963

APRIL SNOWFALL WAS ABOVE AVERAGE IN WESTERN MOUNTAINS, IMPROVING 1963 WATER SUPPLY OUTLOOK. TOTAL SNOWFALL FOR THE SEASON AND STREAMFLOW FORECASTS REMAIN BELOW AVERAGE. WITH STORED WATER, SUPPLIES WILL BE REASONABLY ADEQUATE EXCEPT FOR THE ARKANSAS , RIO GRANDE , SOUTHERN UTAH , AND A FEW OTHER SMALL AREAS.

After a winter season noted for the lack of snow accumulation in the mountains of Western United States, the trend was reversed during April. Snowfall this past month has been at least average, except for the southern Rocky Mountain area. Snowfall of two to three times average occurred in northern and central Utah and the central Sierra of California. This snowfall caused forecasts of streamflow to generally increase 10 percent of average, and in California and northern Utah, as much as 50 percent of average.

For much of the irrigated area of the West, the outlook has changed from that of a limited water supply largely dependent on storage to a reasonably adequate supply for the principal irrigated areas with some opportunity for carryover from 1963.

The greatest improvement in water supply outlook occurred in northern and central Utah, the Central Valley of California, and the east slope of the Sierras in Nevada. This improvement eliminated the threat of serious shortages on Snake River tributaries in Idaho and Oregon and on smaller tributaries in the main Columbia Basin.

Even if the general level of streamflow forecasts has improved, few streams fed from snowmelt are expected to have above average flow this season. Carryover storage from reservoirs remains as the factor responsible for adequacy of water supply over most irrigated areas where demands usually equal the supply.

Not all of the Western States area reported so favorable an improvement for April. A below average seasonal snowpack as of April 1 declined further during April on the headwaters of the Colorado, the Arkansas and the Rio Grande. Forecasts of flow of these streams are now among the lowest ten percent of record. Limited storage and lack of streamflow, a trend indicated throughout the winter season, will restrict irrigation water use severely along the main streams of the Arkansas and Rio Grande. The low flow of the Colorado will delay filling schedules of the new reservoirs of the Upper Colorado River Project.

The outlook for irrigated areas along the streams in southern Utah remains very poor. There is some improvement over the essentially base flow forecasts of April 1, but 1963 will be an extremely short water year. The poor outlook also remains for the Humboldt River of Nevada above Rye Patch Reservoir.

Most of the snowmelt runoff has occurred along the Mogollon River in Arizona and western New Mexico. While streamflow has been below average, carryover storage will provide an average surface water supply for the central Arizona irrigated area.

Streamflow forecasts from streams originating on the Sierra Nevada range of California have increased materially from midwinter and now range generally from 90 to 110 percent of average. With above average storage, the outlook for water in the Central Valley of California and adjacent areas to the east in California and Nevada is now reasonably good. Mountain snowpack doubled in the central Sierras during April at a time when substantial snowmelt is to be expected. Irrigated lands will experience few water problems either in the Central Valley or Colorado Desert areas, except for those areas where demand always exceeds supply.

In confirmation of adequate but not excessive water supplies, the flow of the Columbia River at The Dalles, Oregon is forecast at 75 percent of average for the April-September period, which is the lowest flow for this major stream since 1944. Most reservoirs on tributary streams for both irrigation and power are expected to fill. With stored water, irrigation water supplies will be satisfactory.

Forecasts of Missouri River tributaries in Montana and Wyoming are for less than average streamflow for the summer period, 70 to 90 percent of average. Shortages are expected only in late season along streams with limited or no storage. With the increase in snowfall during March and carryover storage, water supply outlook is good along the Bighorn and North Platte and its tributaries.

In summary, the adequacy of water supply for 1963 is related to storage from the relatively plentiful year of 1962 and high winter runoff. The streamflow pattern in prospect for 1963 would result in water shortage over a wide area if storage was not so favorable.

SUMMARY OF SNOW WATER EQUIVALENT MEASUREMENTS

MAY 1, 1963

MAJOR BASIN AND SUB—WATERSHED	WATER EQUIVALENT IN PERCENT OF: LAST YEAR	AVERAGE
MISSOURI BASIN		
Jefferson	132	95
Madison	117	108
Gallatin	100	96
Missouri Main Stem	95	84
Yellowstone	136	111
Shoshone	761	127
Wind	95	103
North Platte	111	97
South Platte	67	71
ARKANSAS BASIN		
Arkansas	50	54
Canadian		
RIO GRANDE BASIN		
Rio Grande (Colo.)	15	24
Rio Grande above Otowi Bridge	15	20
Pecos		
COLORADO BASIN		
Green (Wyo.)	102	123
Yampa - White	71	77
Duchesne	76	111
Price	84	111
Upper Colorado	33	36
Gunnison	38	43
San Juan	45	54
Dolores	33	43
Virgin	83	64
Gila		
Salt		
GREAT BASIN		
Bear	117	114
Logan	136	105
Ogden	122	106
Weber	130	119
Provo - Utah Lake	131	135
Jordan	120	123
Sevier	89	98
Walker - Carson	115	137
Tahoe - Truckee	74	74
Humboldt		
Lake Co. (Oregon)		
Harney Basin (Oregon)		108
UPPER COLUMBIA BASIN		
Columbia (Canada)	91	84
Kootenai	87	64
Clark Fork	101	91
Bitterroot	94	83
Flathead	75	77
Spokane	63	55
Okanogan	105	73
Methow	147	92
Chelan	107	75
Wenatchee	71	47

MAJOR BASIN AND SUB—WATERSHED	WATER EQUIVALENT IN PERCENT OF: LAST YEAR	AVERAGE
SNAKE BASIN		
Snake above Jackson, Wyo.	90	85
Snake above Hiese, Idaho	110	100
Snake above American Falls Res	95	90
Henry's Fork		
Southern Idaho Tributaries	79	87
Big and Little Wood	121	100
Boise	86	73
Owyhee	146	63
Payette	82	69
Malheur	470	186
Weiser		
Burnt		
Powder	81	
Salmon	106	85
Grande Ronde	91	
Clearwater	81	67
LOWER COLUMBIA BASIN		
Yakima	56	35
Umatilla	100	44
John Day	140	
Deschutes - Crooked	51	43
Hood	69	44
Willamette	53	38
Lewis	56	44
Cowlitz		
PACIFIC COASTAL BASIN		
Puget Sound	73	49
Olympic Peninsula		
Umpqua - Rogue	45	28
Klamath	69	45
Trinity		
CALIFORNIA CENTRAL VALLEY		
Upper Sacramento	105	110
Feather	75	85
Yuba	83	100
American	95	100
Mokelumne	110	110
Stanislaus	111	100
Tuolumne	110	105
Merced	120	100
San Joaquin	126	120
Kings	125	100
Kaweah	128	90
Tule	110	80
Kern	110	110

Data for California Watersheds supplied by Dept. of Water Resources, and for British Columbia Watersheds by Dept. of Lands, Forests and Water Resources.

Average is for 1943-57 period.

Based on Selected Snow Courses determined by Distribution within the Basin, Length of Record and Repetitive Monthly Measurement Schedules.

MISSOURI BASIN

Water supply outlook improved over the Missouri Basin during April along the Continental Divide from central Montana to the North Platte drainage of Colorado. Forecasts of summer flow remain below average for the Missouri, Yellowstone and Platte rivers and their tributaries. Water supply outlook for irrigation is generally satisfactory.

MONTANA

Streamflow forecasts for Upper Missouri tributaries are for about three-quarters of average flow for the snowmelt season. Only the Gallatin River is forecast at near average. Mountain snowpack as of May 1 is near average except for the headwaters of the Marias and Milk rivers, which is about 80 percent of average. With less than average storage, some shortage of water is to be expected along these streams. In addition, late season shortage is in prospect along the Beaverhead. Elsewhere in the state, storage and streamflow will provide a reasonable water supply in 1963.

WYOMING

There was substantial increase in snowpack along the Continental Divide on the headwaters of the Shoshone, Bighorn and North Platte. The range is from near average on the North Platte to 125 percent of average on the Shoshone. This increase has reduced the prospect of limited water shortage on the Shoshone and Wind river tributaries that existed a month ago. The Bighorn Mountain area along with the Black Hills of South Dakota also had substantially above average snowfall in April, resulting in a favorable water supply outlook for irrigated lands adjacent to these mountains.

With carryover storage at near average levels, irrigation water should be adequate on the North Platte and Laramie. Inflow forecasts to Seminoe Reservoir improved during March, but this reservoir will not fill this year, reducing power potential. Storage will be depleted at the end of the season if summer demands are average.

COLORADO

Forecasts have been reduced slightly for the South Platte and its tributaries to about two-thirds of average for the summer months. Storage in smaller reservoirs in the Upper Basin is favorable, and near capacity along the lower South Platte. If summer rainfall is average or less, the use of this storage along with that of the Colorado-Big Thompson system will be required to meet demands. Storage in municipal reservoirs is above average.

ARKANSAS BASIN

The outlook for irrigation water supplies along the Arkansas and its tributaries in Colorado and into western Kansas remains poor. Mountain snow cover on the headwaters declined in respect to average from April 1 to May 1. Streamflow forecasts for the summer months are 50 percent or less than average. There is no storage in John Martin and very little in smaller irrigation reservoirs. Water supply from surface sources will limit crop acreage this year.

The outlook for the Tucumcari Project on the Canadian River is only fair with limited inflow in prospect and considerable early season demand for water.

RIO GRANDE BASIN

Streamflow through the San Luis Valley of Colorado will be near a minimum of record. There was very little snow on the high watersheds during March or April. Remaining snowpack is at or near the lowest of record for May 1. Extreme use of groundwater will again be necessary.

Most of the seasonal snow accumulation has melted in New Mexico. Flow for the remainder of the season for the Rio Grande through New Mexico will be extremely low. The forecast is 20 percent or less of average. Storage in Elephant Butte is much below average. Total surface water supply for the irrigated area of south central New Mexico and west Texas will be only a fraction of average demands.

The outlook for irrigated areas along the Pecos is relatively good. Streamflow forecasts are near average. Much of the runoff has already occurred. Storage is less than for the past two years so the outlook is not as favorable as a year ago.

COLORADO BASIN

The unimpaired flow of the Colorado River near Grand Canyon, Arizona (inflow to Lake Mead) is forecast at 3,700,000 acre-feet or 46 percent of average for the May-September period. This flow is near the lowest of record and about one-third of that for 1962. Actual inflow will be much less, depending on storage in Powell, Navajo and Flaming Gorge reservoirs.

Upper Basin

The seasonal snowpack is much less than average over the entire Upper Basin except for the Green River and central Utah tributaries. There has been very little additional snowfall in March and April, which resulted in a substantial reduction in forecasts for streams from the principal water contributing areas of Wyoming, Colorado and New Mexico. Even if streamflow is below average, water supplies will be adequate along the main tributaries such as the Yampa, White, Upper Colorado, Gunnison, Animas and San Juan rivers. Late

SELECTED STREAMFLOW FORECASTS MAY - SEPTEMBER AS OF MAY 1, 1963

STREAM AND STATION	1000 ACRE-FEET		PERCENT OF AVERAGE
	FLOW 1962	FORECAST 1963	
UPPER MISSOURI			
Clark Fork at Chance, Montana	573	450	76
Gallatin near Gateway, Montana	523	407	94
Jefferson at Sappington, Montana	782	709	78
Madison near Grayling, Montana 1/	420	275	71
Missouri near Zortman, Montana 2/	3631	2960	71
Missouri near Williston, N. Dakota 3/	11564	8050	76
Yellowstone at Corwin Springs, Montana	2119	1480	79
Yellowstone at Miles City, Montana	6441	4874	79
Shoshone below Buffalo Bill Res., Wyoming 4/		630	78
Wind at Dubois, Wyoming		74	80
PLATTE			
Clear at Golden, Colorado 5/		94	71
North Platte at Saratoga, Wyoming		415	72
Cache LaPoudre near Ft. Collins, Colorado 6/		115	63
ARKANSAS			
Arkansas at Salida, Colorado 7/		158	50
RIO GRANDE			
Rio Grande near Del Norte, Colorado 8/		230	51
Rio Grande at Otowi Bridge, New Mexico 9/ (May-July)		90	20
Pecos at Pecos, New Mexico *		39	95
UPPER COLORADO			
Animas at Durango, Colorado		265	62
Colorado at Glenwood Springs, Colorado 10/		960	67
Colorado near Cisco, Utah		2100	58
Colorado near Grand Canyon, Arizona 11/		3700	46
Duchesne near Tabiona, Utah 12/		101	96
Green near Greendale, Utah 13/		900	68
Green near Green River, Utah 13/		1600	52
Gunnison near Grand Junction, Colorado		690	57
Price near Scofield, Utah 14/		28	82
San Juan near Bluff, Utah 15/		475	45
White at Meeker, Colorado		162	53
Yampa at Steamboat Springs, Colorado		178	74
LOWER COLORADO			
Gila at Virden, Arizona (Apr-May)	47	12	88
Salt at Intake, Arizona (Apr-May)	311	70	56
Verde above Horseshoe Dam, Arizona (Apr-May)	58	23	41
GREAT BASIN			
Bear at Harer, Idaho 16/		142	60
Logan near Logan, Utah 17/		92	74
Ogden, Inflow to Pine View Res., Utah 18/ (May-July)		73	95
Provo at Vivian Park, Utah 19/		114	88
Sevier at Hatch, Utah 20/		16	35
Sevier near Kingston, Utah		3	14
Humboldt at Palisades, Nevada **	207	40	24
Truckee at Farad, California ** 21/	147	100	57
West Walker near Coleville, California **	126	95	73

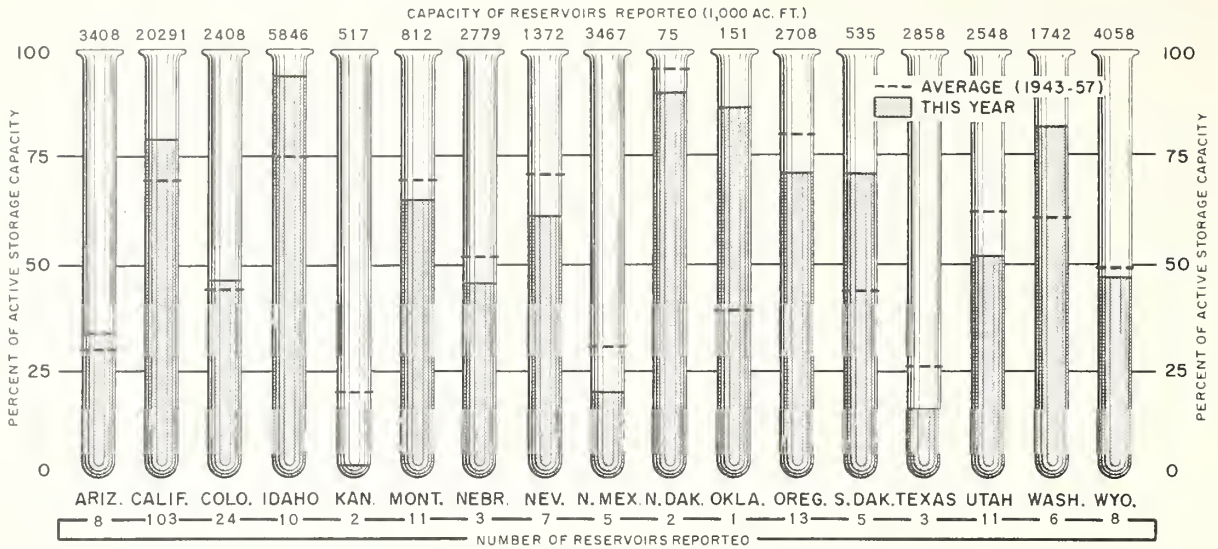
Forecasts in California provided by Department of Water Resources.
Average is for 1943-57 period except California. California is computed for 1908-57 period.
Forecasts assume average Effective Climatic Conditions from Date Through Snow Melt Season.

SELECTED STREAMFLOW FORECASTS MAY - SEPTEMBER AS OF MAY 1, 1963

STREAM AND STATION	1000 ACRE-FEET		PERCENT OF AVERAGE
	FLOW 1962	FORECAST 1963	
UPPER COLUMBIA			
Bitterroot near Darby, Montana	452	365	70
Chelan at Chelan, Washington 22/		790	68
Clark Fork above Missoula, Montana	1536	1355	86
Clark Fork at Whitehorse Rapids, Montana 23/	10803	9280	77
Columbia at Revelstoke, British Columbia		18000	102
Columbia at Birchbank, British Columbia 24/		36000	88
Columbia at Grand Coulee, Washington 24/	54507	51850	85
Columbia at The Dalles, Oregon 24/		69000	75
Flathead near Polson, Montana 23/	5795	5220	79
Kootenai at Wardner, British Columbia		3200	73
Kootenai at Leonia, Idaho	6531	5460	68
Okanogan near Tonasket, Washington	1084	1060	60
Spokane at Post Falls, Idaho 25/		1610	76
SNAKE			
Big Lost, Inflow to Mackay Res., Idaho 26/		105	66
Big Wood, Inflow to Magic Res., Idaho 27/			
Boise above Diversion Dam, Idaho 28/		750	57
Clearwater at Spalding, Idaho		5150	72
Malheur near Drewsey, Oregon		17	47
Owyhee Res. Net Inflow, Oregon 18/		40	19
Payette near Horseshoe Bend, Idaho 29/		1060	65
Salmon at Whitebird, Idaho		4700	75
Snake near Heise, Idaho 30/		2550	69
Snake at Weiser, Idaho		3250	66
LOWER COLUMBIA			
Cowlitz at Castle Rock, Washington	1820	1420	65
Deschutes at Benham Falls, Oregon 31/ (Apr.-Sept.)		390	65
Grande Ronde near LaGrande, Oregon		56	47
Hood near Hood River, Oregon 32/		160	60
Willamette at Salem, Oregon 33/ (Apr.-Sept.)		3850	70
Yakima near Parker, Washington 34/		650	43
NORTH PACIFIC COASTAL			
Dungeness near Sequin, Washington	109	113	70
Rogue at Raygold near Central Point, Oregon		475	65
Klamath Lake, Net Inflow, Oregon 35/		260	60
CALIFORNIA CENTRAL VALLEY 36/**			
American, Inflow to Folsom Res., Calif.	1272	1480	107
Feather near Oroville, Calif.	1825	2200	110
Kaweah near Three Rivers, Calif. 37/	310	235	88
Kern near Bakersfield, Calif.	515	380	85
Kings, Inflow to Pine Flat Res., Calif.	1485	1020	84
Merced, Inflow to Exchequer Res., Calif.	662	580	93
Mokelumne, Inflow to Pardee Res., Calif.	508	430	89
Sacramento, Inflow to Shasta Res., Calif.	1506	2650	146
San Joaquin, Inflow to Friant Res., Calif.	1486	1300	106
Stanislaus, Inflow to Melones Res., Calif.	779	645	86
Tule, Inflow to Success Res., Calif.	49	45	73
Tuolumne, Inflow to Don Pedro Res., Calif.	1317	1140	94
Yuba at Smartville, Calif.	1142	1150	102

Explanatory Notes on Forecasts Listed on Inside Back Cover.
** April - June Period ** April - July Period*

RESERVOIR STORAGE as of MAY 1, 1963



season shortage will be common for the irrigated areas along smaller tributary streams.

April snowfall was near a record high 200 to 300 percent of average for central Utah, and to a lesser degree on the Green River in Wyoming. Forecasts on Green River tributaries in Utah increased from about 50 percent of average to 80 to 90 percent of average as a result of record snowfall. Lack of melting during April added to the present snowpack. Water supply outlook for this area is below average but substantially improved over the outlook through the winter months up to April 1.

There was some increase in snowpack on the Virgin River during April, but streamflow for 1963 will be critically low, among the lowest of record.

ARIZONA

Irrigation water supply is near average. Runoff during the spring months has been generally below average, but storage at the start of the season was relatively good in major reservoirs of the Salt River Project, but limited on the Verde and Little Colorado River watersheds.

Streamflow forecasts for the April-May 1963 period now range from 30 percent of average on the Verde to 80 percent of average on the Upper Gila. Surface water supplies are near average for the large irrigated areas, but continued drafting of groundwater supplies will be necessary to meet water demands in central Arizona.

GREAT BASIN

UTAH

After a winter of extremely short snowfall, mountain snow and rainfall in the central and northern areas of Utah during April varied from 200 to 350 percent of average, drastically changing the water supply outlook. Near average prospects for water supply now exist on the Ogden, Weber, Provo, the Bear above Evanston, Wyoming, and the Cottonwood Creeks near Salt Lake. Less favorable but improved outlook is in prospect for the Lower Bear River and the tributaries to Utah Lake.

While snowfall was above average on the Beaver and Sevier rivers during April, the outlook remains extremely poor. A similar outlook prevails in the southeastern Utah streams.

NEVADA

Snowpack on the central Sierra headwaters of the Truckee, Carson and Walker rivers in western Nevada doubled during April. During April a decline in mountain snowpack is expected. The heavy snowfall in April was not sufficient to overcome the lack of snowfall during the winter months. Forecasts of these streams now range from 50 to 75 percent of average. Water supply outlook for water users with storage available is relatively good.

Water supply along the Humboldt, especially above Rye Patch Reservoir, remains generally poor.

Much of the present above average reservoir storage in the state will be used to meet water use needs this summer. There will probably be little carryover for next season.

OREGON

There was substantial snowfall and rainfall in south central Oregon during April. Streamflow has been high, and soil moisture conditions are good. Total summer streamflow will be below average, and shortages of water in late season are in prospect.

STORAGE IN LARGE RESERVOIRS

MAY 1, 1963

BASIN AND NAME OF RESERVOIR	CAPACITY (1000A.F.)	STORAGE (1000A.F.)
UPPER MISSOURI		
Boysen	560	331
Buffalo Bill	380	134
Canyon Ferry	2043	1985
Hebgen	385	308
Tiber	1316	647
Belle Fourche	185	182
Keyhole	190	68
Fort Peck	19410	10244
Fort Randall	6100	3504
Garrison	24500	12650
Oahe	23600	10925
PLATTE		
Glendo	786	423
Pathfinder	1011	452
Seminoe	982	372
Colo-Big Thompson (4)	865	497
City of Denver (4)	218	168
ARKANSAS		
Conchas	600	169
John Martin	367	0
RIO GRANDE		
Elephant Butte	2207	353
El Vado	194	14
UPPER COLORADO		
Flaming Gorge	3789	165
Navajo	1709	217
Powell	28040	697
LOWER COLORADO		
Havusu	619	590
Mead	27207	21054
Mohave	1810	1734
San Carlos	1206	106
Salt River Res. (4)	1755	1003
Verde River Res. (2)	322	36
GREAT BASIN		
Bear	1421	804
Lahontan	286	284
Rye Patch	179	77
Sevier Bridge	236	73
Strawberry	270	64
Tahoe	732	321
Utah	1149	348

BASIN AND NAME OF RESERVOIR	CAPACITY (1000A.F.)	STORAGE (1000A.F.)
UPPER COLUMBIA		
Chelan	676	358
Coeur d'Alene	238	182
Flathead	1791	966
Hungry Horse	3428	2535
Kootenay	817	361
Pend Oreille	1561	1043
Roosevelt	5232	2795
LOWER COLUMBIA		
Detroit	300	266
Hills Creek	200	185
Lookout Point	337	300
Yakima Res. (5)	1065	1047
SNAKE		
American Falls	1700	1733
Arrowrock	287	284
Anderson Ranch	423	355
Brownlee	1427	1423
Cascade	653	600
Jackson	847	631
Lucky Peak	278	256
Palisades	1202	1189
Owyhee	715	378
PACIFIC COASTAL		
Clear Lake (Ore.)	440	155
Upper Klamath	584	555
Ross	1203	1095
Trinity	2500	2439
CALIFORNIA CENTRAL VALLEY		
Almanor	650	587
Berryessa	1600	1614
Cachuma	206	185
Casitas	248	51
Cherry Valley	268	162
Don Pedro	260	209
Folsom	1010	759
Hetch-Hetchy	360	152
Isabella	552	212
McClure	281	248
Millerton	503	495
Nacimiento	350	292
Pardee	210	170
Pine Flat	1001	657
Shasta	4500	4405

Reservoir Storage Data Provided by Bureau of Reclamation, Corps of Engineers, Geological Survey, and water using organizations. Data from California and British Columbia provided by Department of Water Resources and Department of Lands, Forests and Water Resources, respectively.

COLUMBIA BASIN

Snowfall over the United States section of the Columbia Basin was average or better during April but far short of that necessary to overcome the deficiency in snow accumulation during the winter months. Cool temperatures during April prevented material snowmelt. Streamflow has been much below average except for the Canadian section of the basin. The flow of the Columbia at The Dalles, Oregon, for the May-September 1963 period is forecast to be 69,000,000 acre-feet, or 75 percent of average, the lowest for this period since 1944.

BRITISH COLUMBIA

The Water Resources Service of British Columbia reports that there was a substantial increase in snow cover in respect to average along the Fraser-Columbia River Divide during April. Near average conditions occurred on the main Columbia and Kootenay watersheds. Forecasts of flow of the Columbia in Canada range from near average at Revelstoke to about 90 percent of average at Birchbank near the international border. The flow of the Kootenay is forecast at 73 percent of average near its headwaters and slightly less as inflow to Kootenay Lake.

With increases in flow forecasts, the probability of some water shortage on the Similkameen and Okanagan rivers has been reduced.

MONTANA

Streamflow forecasts increased slightly in western Montana during April as a result of more than average snowfall. The increase is relatively light as compared to most other areas in the basin. Forecasts of major streams are now 70 to 80 percent of average. Power reservoirs will fill. Irrigation water supplies will be satisfactory except for late season along the Bitterroot.

IDAHO

April storms improved water supply outlook along the Snake River and its tributaries in Idaho. Streamflow forecasts remain below average, but storage in major reservoirs is well above average and near capacity. Water supply outlook for the main stem of the Snake, the Boise and Payette is excellent. Water supplies for the smaller tributary streams also improved. April snow and rainfall not only increased the prospects for streamflow but reduced the water demand by eliminating the necessity for early irrigation over practically all of the state.

OREGON

April snowfall was high over Oregon, improving the deficiency in water supply outlook that existed during the winter months. Reservoir storage increased, and the need for early season use of stored water has been delayed. Streamflow forecasts for the remainder of the season have improved slightly. Most forecasts are now in the range of 60 to 80 percent of average except for southern and southeastern streams where forecasts are somewhat less. Where storage is not available, late season water supplies will be poor unless above normal rainfall continues through the summer months.

WASHINGTON

April storms in Washington improved water supply outlook, but streamflow forecasts for the remainder of the season are much below average. The improvement in outlook during April eliminated the prospect of any water shortage except some possibility in late season where storage is limited. Storage and streamflow will provide adequate water supplies along the main streams.

Winter runoff was high. Cool temperatures during April delayed snowmelt.

CALIFORNIA

The California Department of Water Resources, coordinating agency for snow surveys in California, reports that water supplies will be near normal in most areas of California during the current season of major use--which has now begun. The principal hydrologic factors influencing water supply conditions (reservoir storage, precipitation, snowpack, and streamflow) are all near or above normal on the basis of May 1 data. Although these factors are now near normal, the season which produced them certainly was not, and the vagaries of California weather were again dramatically demonstrated. March, with above normal precipitation, was followed by an extremely wet April (200 to 400 percent of average in many areas) which further confirmed the degree of variance from normal conditions which can occur.

Although precipitation was near normal early in the season, on February 1 by virtue of two flood-intensity storms, snowpack was almost non-existent. However, snowpack build-up began in mid-March, and as of May 1 was near normal in most areas.

Although conditions as of May 1 are generally quite satisfactory, there will be limited shortages in localized areas throughout the state this season--as there are in any season. However, these isolated shortages relate primarily to development, storage, or distribution problems rather than to supply potentials. The southern portion of the state will have its ever-present problem of inadequate local supplies. This problem, though, is essentially one of degree since use in this area far exceeds local supplies in even the best years.

Precipitation occurred in light to moderate amounts almost daily during April in all but the southeastern desert region. Most areas north of the Tehachapis received amounts in

the order of 300 percent of normal during the month. Accumulated precipitation since October 1, 1962 through April 30 was still subnormal in the southern portion of the state (Bakersfield south). However, seasonal precipitation in the northern two-thirds of the state has been generally about 130 percent of normal.

May 1 snowpack was normal or above in the major snow accumulation areas of the state. This was an almost unbelievable improvement over the 32 to 40 percent of average that existed just one month ago. Usually the April snowmelt reduces the pack by about 25 to 30 percent; however, a complete reversal of this usual pattern occurred during April this year. On May 1 many courses reported double the water content that was present on April 1.

Reservoirs in California gained 1,400,000 acre-feet of storage during April and on May 1 held 112 percent of their 10-year average May 1 content.

The Sacramento Valley reservoirs filled to 93 percent of their aggregate capacity, and the major reservoirs of the northern coastal area were 98 percent of capacity. San Joaquin Valley reservoirs filled more slowly during April but retained 61 percent of their combined capacity, which amounts to 129 percent of the 10-year May 1 average. It can therefore be concluded that, in general, California has an abundance of water in storage for use in the 1963 irrigation season.

Groundwater levels generally rose in the northern and lowered in the southern part of the state, with a further decline in many areas of the San Joaquin Valley because of heavy pumping. However, because of above normal winter rains, levels rose in several areas along the eastern edge of the Valley from the spring of 1962. Sea water continued to intrude in most of the southern and central coastal basins.

EXPLANATION of STREAMFLOW FORECASTS

1/ Observed flow adjusted for change in storage in Hebgen Lake. 2/ Observed flow adjusted for change in storage in Canyon Ferry and Tiber reservoirs. 3/ Observed flow adjusted for change in storage in Canyon Ferry, Tiber, Fort Peck, Buffalo Bill, and Boysen reservoirs. 4/ Observed flow adjusted for change in storage in Buffalo Bill Reservoir plus Heart Mt. Diversion. 5/ Observed flow minus diversion through Jones Pass Tunnel.

6/ Observed flow minus diversions from North Platte, Colorado and Laramie rivers plus measured diversions for irrigation and municipal use above station. 7/ Observed flow adjusted for change in storage in Clear Creek, Twin Lakes and Sugar Loaf reservoirs minus trans-mountain diversions through Busk-Ivanhoe and Twin Lakes Tunnels and Ewing, Fremont, Wurtz and Columbine Ditches. 8/ Observed flow adjusted for change in storage in Santa Maria, Rio Grande and Continental reservoirs. 9/ Observed flow adjusted for changes in storage in reservoirs listed in (8) plus Terrace, Sanchez, Platoro, and El Vado reservoirs. 10/ Observed flow adjusted for changes in storage in Granby Reservoir plus diversions through Adams Tunnel and Grand River Ditch.

11/ Observed flow adjusted for changes in storage in Flaming Gorge, Navajo, and Lake Powell. 12/ Observed flow plus diversion through Duchesne Tunnel. 13/ Observed flow adjusted for changes in storage in Flaming Gorge Reservoir. 14/ Observed flow adjusted for change in storage in Scofield Reservoir. 15/ Observed flow adjusted for change in storage in Navajo Reservoir.

16/ Observed flow adjusted for change in storage in Bear Lake Reservoir. 17/ Observed flow plus Utah Power and Light Tailrace and Logan, Hyde Park and Smithfield canals. 18/ Record computed by Bureau of Reclamation. 19/ Observed flow adjusted for change in storage in Deer Creek Reservoir, minus diversions through Duchesne Tunnel and Weber-Provo Canal, plus diversion through Salt Lake Aqueduct. 20/ Observed flow adjusted for change in storage in Otter Creek Reservoir.

21/ Observed flow adjusted for change in storage in Boca Reservoir but not Lake Tahoe. Forecast by Truckee Basin Water Committee. 22/ Observed flow adjusted for change in storage in Lake Chelan. 23/ Observed flow adjusted for change in storage in Flathead and Hungry Horse Reservoir. 24/ Observed flow adjusted for change in storage in any or all of the following reservoirs above the station: Kootenay Lake, Hungry Horse, Pend Oreille, Coeur d'Alene, F. D. Roosevelt, Lake Chelan, and Brownlee; and pumping to Banks Lake. 25/ Observed flow adjusted for change in storage in Coeur d'Alene Lake plus diversions to Spokane Valley Farms and Rathdrum Prairie Canals.

26/ Observed flow adjusted for change in storage in Mackay Reservoir plus diversion in Sharp Ditch. 27/ Combined flow of Big Wood near Belleview and Camas Creek near Blaine. 28/ Observed flow adjusted for changes in storage in Lucky Peak, Anderson Ranch and Arrowrock Reservoir. 29/ Observed flow adjusted for changes in storage in Cascade and Deadwood Reservoir. 30/ Observed flow adjusted for changes in storage in Palisades and Jackson reservoirs.

31/ Observed flow adjusted for changes in storage in Crane Prairie, Wickiup, and Crescent Lake reservoirs. 32/ Adjusted to natural flow. 33/ Observed flow adjusted for changes in storage in Lookout Point, Detroit, Cottage Grove, Dorena, and Hills Creek reservoirs. 34/ Observed flow adjusted for changes in storage in Keechelus, Kachess, Cle Elm, Bumping and Tieton reservoirs, plus diversions by Rosa, New Reservation, Old Reservation, and Sunnyside Canals. 35/ Flow records provided by COPCO and USBR.

36/ All forecasts are for unimpaired streamflow except Kaweah River. 37/ Not corrected for upstream impairments. All other forecasts are for observed flow.

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